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ABSTRACT

A study was undertaken to examine the impact of the paralinguistic channel on the ability to encode facial expressions of emotion. The first set of subjects, 19 encoders, were asked to encode facial expressions for five emotions (fear, sadness, anger, happiness, and disgust). The emotions were produced in three encoding conditions: facial channel alone, facial channel plus paralinguistics, and facial channel plus mouthing. The second set of subjects, 60 decoders, were shown silent videotapes of encoders' facial expressions. Decoders' accuracy in detecting the intended emotions was used as an index of communication accuracy. The results indicated that access to the paralinguistic channel had both facilitative and inhibitory effects on accuracy of communication by the facial channel. The direction of the effect was dependent on the emotion encoded. In addition, it was found that the impact of paralinguistics on the facial channel was due to the systematic face movements concomitant to talking rather than to the production of appropriate vocal intonations. It was suggested that facial movements inhibited emotions expressed in the upper half of the face, but facilitated emotions expressed in the lower half of the face. (Author/RL)

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MULTICHANNEL COMMUNICATION: THE IMPACT OF THE PARALINGUISTIC CHANNEL ON FACIAL EXPRESSION OF EMOTION

by

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Report from the Project on
Studies of Instructional Programming for the Individual Student

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Abstract

This study examined the impact of the paralinguistic channel on the ability to encode facial expressions of emotion. Subjects (encoders) were asked to encode facial expressions for five emotions (fear, sadness, anger, happiness, and disgust). The emotions were produced in three encoding conditions--facial channel alone, facial channel plus paralinguistics, and facial channel plus mouthing. Subjects (decoders) were shown silent videotapes of encoders' facial expressions. Decoders' accuracy in detecting the intended emotions was used as an index of communication accuracy. The results indicated that access to the paralinguistic channel had both facilitative and inhibitory effects on accuracy of communication by the facial channel. The direction of the effect was dependent on the emotion encoded. In addition, it was found that the impact of paralinguistics on the facial channel was due to the systematic face movements concomitant to talking rather than the production of appropriate vocal intonations. It was suggested that facial movements inhibit emotions expressed in the upper half of the face, but facilitate emotions expressed in the lower half of the face.

Providing tutoring help to students has been a valuable addition to the school system. Gains in scholastic achievement as a result of tutoring have been found for both tutors and tutees (Allen, 1976). To develop better tutoring programs, it is important to find effective ways for training tutors in teaching techniques relevant to the tutoring situation. A first step in this direction is the identification of those skills most important for teaching on a one-to-one basis.

One of the greatest advantages of tutoring is that the tutor can adapt the lesson to fit the tutee's rate of comprehension. In addition, the tutor can increase the tutee's interest and enjoyment of the learning process by providing both positive reinforcement for success and support during failure. To accomplish these goals, the tutor must be socially skilled in dyadic interactions.

An important social skill for the tutor will be his or her ability to encode (produce) and decode (interpret) nonverbal behavior. For example, a tutor who is skilled at accurately decoding nonverbal behavior will be able to detect quickly that the tutee is having difficulty understanding the lesson. In addition, positive reinforcement must be expressed nonverbally as well as verbally in order to be effective. Research has shown that observers often place more weight on information from the nonverbal than the verbal channel (Mehrabian, 1971). Thus, a training program for tutors should devote time to training tutors in nonverbal

skills that will aid them in the tutoring situation. To develop such training techniques, it is necessary to extend our knowledge of nonverbal communication.

Nonverbal communication is "all human responses which are not described as overtly manifested words (written or spoken)" (Knapp, 1972). The bulk of research on nonverbal behavior has focused on five communication channels: facial expressions, paralinguistics (noncontent aspects of speech), visual behavior, body language, and spatial behavior. Research has demonstrated that people are able to accurately encode and decode information (e.g., emotion) by means of nonverbal behavior. Research on nonverbal behavior, however, has consisted largely of investigations within a single channel. As Mehrabian and Ferris (1967) state: "While there are many studies of nonverbal attitude or feeling communication in single channels, investigators have only begun to explore simultaneous transmitted feelings or attitudes in two or more channels" (p. 248).

To date, research on multichannel communication has emphasized decoding. It has been found that observers' judgments of affect, inferiority-superiority, and liking are more influenced by the nonverbal than the verbal channel (Argyle, Alkema, & Gilmour, 1971; Argyle, Salter, Nicholson, Williams, & Burgess, 1970; Bugental, Kaswan, & Love, 1970; Bugental, Kaswan, Love, & Fox, 1970; Mehrabian & Ferris, 1967). The multichannel research has, however, neglected the question of the interdependence of nonverbal channels for encoding nonverbal responses.

The present study addresses the question of the interdependence of two nonverbal channels--namely, the facial and paralinguistic channels. Is the ability to encode facial expressions of emotion influenced by the paralinguistic channel? It is obvious that vocalization must lead to physical changes in the face, but do these changes facilitate or inhibit encoding emotions by the face? A study by Zuckerman, Hall, DeFrank, and Rosenthal (1976) examined the impact of talking on the accuracy of encoding by the facial channel. Results indicated that talking while encoding produced less accurate facial displays than not talking (for both spontaneous and posed expressions). The causal factor for this difference is not clear, however. The poorer performance in the talking condition could be attributed to situational artifacts. Spontaneous subjects were asked to view affect-eliciting videotapes; posed subjects were told to communicate a particular affect; but subjects who talked were merely asked to describe the videotape. The three situations differed not only in the presence or absence of talking, but also in the experienced intensity of a particular emotion and in emphasis on accuracy of communication. In addition, the study was not concerned with paralinguistics, but with the impact of talking, per se. Whether or not the subjects encoded affect paralinguistically is not specified.

The present study systematically investigated the impact of paralinguistics on the ability of subjects to encode by facial expressions. Individuals were asked to encode facial expressions of emotion with or without access to the paralinguistic channel. Using the paralinguistic

channel is hypothesized to have two effects: (a) the production of appropriate vocal intonations, and (b) the production of systematic facial movements concomitant to speech. To determine which factor may influence accuracy of communicating by the facial channel, a third encoding condition was included. The encoders were asked to "mouth" the standard sentences employed in the facial channel plus paralinguistics condition. That is, they were asked to replicate the mouth movements employed when speaking the standard sentences, but to withhold vocalizations. Thus, the present study involved three encoding conditions: facial channel alone, facial channel plus paralinguistics, and facial channel plus mouthing.

Observers were shown silent videotapes of the encoders' facial expressions and then asked to identify the displayed emotion. Decoding accuracy was used as an index to assess the accuracy of communication in each of the encoding conditions. The present study also examined intensity of emotion by asking subjects to encode slight, moderate, and extreme expressions of each emotion in the three conditions.

Several questions were addressed to the present study. First, does the paralinguistic channel have an impact on the ability to encode facial expressions of emotion? It is expected that the facial channel will be influenced by the paralinguistic channel. Specifically, we predict that accuracy of encoding facial expressions of emotion will differ between the facial channel alone and the facial channel plus paralinguistics conditions.

Contrasting predictions can be made. It is possible that access to the paralinguistic channel will have a facilitative effect on encoding facial expressions of emotion. Subjects will be more accurate in encoding facial expressions of emotion when they have access to the paralinguistics channel, compared to the facial channel. This prediction is based on an association model. In natural situations, communication is most often accomplished through multiple channels. Thus, access to both communication channels represents a situation that approximates the natural situation and, therefore, may help retrieve the appropriate facial cues.

We may also speculate on biological considerations. The vocal intonations that differentiate emotions may be best produced by specific facial expressions--a different facial configuration is required to produce a high, rising tone compared to a low, falling tone. Encoding the appropriate intonations, therefore, necessitates the production of appropriate facial expressions. An alternate prediction is that access to the paralinguistic channel will have an inhibitory effect on the encoding of facial expressions of emotion: Subjects will be more accurate at encoding facial expressions of emotion in the facial channel alone, compared to the facial channel plus paralinguistics condition. This prediction follows from an equilibrium or attention model of nonverbal communication. More emotion expressed through one channel represents a loss of expressiveness through the second channel. When subjects are asked to encode by facial expressions, their full attention will be focused on the production of the appropriate facial expressions. The added task of

communicating by paralinguistics will serve to distract the subject from the facial channel.

Other general questions addressed in the present study concern sex effects and intensity of the encoded emotion. Do males and females differ in their ability to encode facial expressions of emotion? It is predicted that female encoders will be more accurate than males at communicating facial expressions of emotion. This prediction is based on research conducted by Buck and his colleagues (Buck, Miller, & Caul, 1974; Buck, Savin, Miller, & Caul, 1972). Buck et al. (1972) found that communication accuracy was higher for female encoding and decoding pairs than for male pairs. In their study it was impossible to determine whether the sex difference was due to encoding ability or decoding ability. Therefore, another study was conducted in which sex of encoder and decoder was varied systematically (Buck et al., 1974). Results showed that the female superiority in the 1972 study was due to greater encoding ability. No sex differences were found for the sex of the decoder. Thus, in the present study, a main effect for sex of encoder is predicted.

Do males and females differ in their ability to decode facial expressions of emotion? We predict that female and male decoders will not differ in their ability to discern facial expressions of emotion. A review of sex differences in decoding ability (Hall, 1978) indicated that the majority of studies did not find significant effects for sex in the ability to decode facial expressions. This prediction is also supported by the aforementioned Buck et al. (1974) study. Thus, the main effect for

the sex of decoder is expected to be nonsignificant.

Does accuracy of decoding facial expressions differ as a function of intensity of emotion encoded? Accuracy of decoding is expected to be greatest for extreme expressions of emotion and lowest for slight expressions, with accuracy for moderate expressions being midway between. This prediction is based on the assumption that by increasing the intensity of an emotion the encoders will provide clearer nonverbal cues. Thus, the task of correctly discerning an emotion should be simplified. A main effect for intensity of emotion is predicted.

Method

Encoding Phase

Subjects. The subjects were 9 male and 10 female undergraduates who were solicited during registration for summer session classes. These subjects acted as encoders for the present study; they were paid $2.50 for their participation.

Apparatus. The encoders were videotaped with a Panasonic videotape camera (model WR-340P) and a Sony videotape player (model 3650) while seated on a couch approximately 8 meters from the camera. The zoom lens of the camera was adjusted to provide a close-up picture of the encoder's face and shoulders.

Design. The encoding phase was conducted as a totally within-subjects design. The independent variables were: intensity of emotion (slight/moderate/extreme), encoding condition (facial channel alone, facial channel plus paralinguistics, facial channel plus mouthing), and emotions (fear, anger, sadness, happiness, and disgust).

Procedure. Encoders participated individually in a 45-minute experimental session. The subject was met by a female experimenter and taken to the experimental room. After the encoder was seated, the experimenter read the following instructions:

> In this study we are concerned with a person's ability to express emotions. You will be asked to display a number of emotions by means of various modes of communication. The five emotions are:

fear, sadness, happiness, anger, and disgust--each expressed at three levels of intensity (slight, moderate, and extreme). Examples are slight happiness, moderate happiness, and extreme happiness. I will make a videotape in all cases. Three modes of expressing the various emotions will be used. First, you will express the emotion by means of nonverbal behavior only. That is, you should try to produce the facial expressions that you think are indicative of the particular emotion. A tape-recorded standard sentence will help you to gauge the length of filming time. Second, you will express the emotions by using both nonverbal behavior and mouth movements. In this case, you should express nonverbally the appropriate emotion while mouthing the standard sentence. That is, you should move your mouth as if speaking the standard sentence, but do not make any sound. The third (and last) mode of communication adds sound and intonation. In this case, while saying the standard sentence you should also try to convey the emotion by nonverbal behavior and by the tone of your voice as well. Before each trial I will tell you: (a) the type of emotion to express (fear, anger, sadness, happiness, or disgust), (b) the intensity of the emotion (slight, moderate, or extreme), and (c) the encoding condition (facial channel alone, facial channel plus paralinguistics, facial channel plus mouthing). The order will be completely random. When you are ready I will start the camera and tape-recorder. After 5 seconds I will give you a start signal. At this point, produce the appropriate emotion

in the specified manner. It should take about 5 seconds. To allow for some variation, I will videotape for 7 seconds after the start signal. That is, the whole film segment will be 12 seconds from start to end. There will be a practice session before starting. Are there any questions?

All encoders received the same instructions; that is, all encoders participated in all cells of the design.

The standard sentences employed were: "I feel yov men dos about what happened today. It was a nim cey experience." The nonsense syllables were used instead of words appropriate to the five emotions (e.g., I feel sad ..., I feel happy ..., etc.) to avoid lip reading by decoders during the decoding phase of the present study. Following the instructions, subjects were given a consent form to read. The form obtained their agreement to participate in the study, to be videotaped, and to allow the videotapes to be shown to observers. All subjects agreed to the details specified in the consent form.

After agreeing to be in the study, the encoders were given a practice session to familiarize them with the procedure, experimental conditions, and the standard phrase. During the practice session, encoders were asked to express interest and surprise for each of the three encoding conditions. The encoders were encouraged to use pronunciations that resulted in a smooth reading of the standard sentence, but variations in the pronunciation of the nonsense syllables were permitted.

Prior to each experimental session a random order of presentation was prepared. The encoding sequence for the five emotions by three

experimental conditions was randomly determined. Intensity of emotion was randomized within each combination of emotion and experimental condition. In other words, the three levels of intensity were encoded sequentially but were not ordered by magnitude (slight to moderate to extreme); instead, the progression of the intensity level was randomly selected from the six combinations possible.

The videotaping began when the encoder had finished the practice session. Prior to each videotaping segment, the encoder was told which emotion to express, the intensity of the emotion, and the experimental condition. When the encoder was prepared, the videotape player was turned on, and after 5 seconds the experimenter gave the encoder the cue to begin. The encoder was videotaped for 7 seconds following this cue. (Pretesting had shown that 5 seconds was needed to complete the sentence at a moderate rate. To allow for individual variations, the videotaping was extended to 7 seconds.) Following each videotaping segment the encoder was told the emotion, intensity, and mode of communication to use for the next videotape segment. This procedure was repeated until the 45 videotape segments were completed. At the end of the session subjects were debriefed, paid, and thanked for their participation in the study.

Decoding Phase

Stimulus tapes. The original tapes from the encoding phase consisted of 45 tape segments for each of the 19 encoders (3 encoding conditions x 3 intensity levels x 5 emotions). Three stimulus tapes were prepared for presentation to decoders--one tape presented emotions expressed at the slight intensity level, one presented emotions expressed at the moderate

intensity level, and one for emotions expressed at the extreme intensity level. Six-second tape segments (beginning at the point when the encoder received the start signal) were edited from the original tapes. All 19 encoders appeared on each stimulus tape and each encoder displayed all of the five emotions in each experimental condition. The videotape segments were randomly ordered on each stimulus tape.

Thus, each stimulus tape consisted of 285 videotape segments (19 encoders x 3 encoding conditions x 5 emotions) and was approximately 1 hour and 30 minutes in duration.

Subjects. The subjects who served as decoders were 30 male and 30 female undergraduates enrolled in an introductory psychology course. All subjects received experimental credits for their participation in the study. Each stimulus tape was viewed by 10 male and 10 female decoders.

Apparatus. The stimulus tapes were presented to the decoders by means of a closed-circuit television system that consisted of a Sony videotape recorder (model number 3650) and a RCA Lyceum 66 cm studio monitor (model number JR345B). The decoders were seated at a table approximately 10 m from the monitor, and dividers separated the decoders to insure independent judgments.

Design. The decoding phase consisted of a mixed factorial design. The between-subjects variables were sex of decoder (male or female) and intensity of emotion (slight, moderate, extreme). The within-subjects variables were sex of encoder (male or female), encoding condition (facial channel alone, facial channel plus paralinguistics, facial channel plus mouthing), and

emotion (fear, anger, sadness, happiness, and disgust).

Procedure. Due to the length of the stimulus tape, the decoders participated in two 50-minute sessions. During the first session the experimenter read the following instructions to the decoders:

> Today, I am going to show you a number of videotape segments of students from an earlier study. These students were videotaped while expressing five different emotions. Your task will be to identify the emotion in a given tape segment. The tape you will see is a sample of the original tapes. The order of the stimulus persons and the emotions has been randomized. After viewing a tape segment, I will ask you to indicate what emotion you think the person was conveying. It will be one of five emotions: either happiness, sadness, anger, fear, or disgust. I will now explain in more detail the procedure we will be following. First, I will play a tape segment and it will be shown on the monitor at the front of the room. It will last approximately 6 seconds. You should watch carefully and try to decide what emotion the person is conveying. At the end of the tape segment the picture will go to snow. At this point you should give your answer. Even if you should decide on the emotion early in the film you should watch the full tape segment before writing down your answer. Now look at the response booklet in front of you. To indicate your choice of emotion, merely place a checkmark in front of the emotion you have chosen. After making your responses, turn the page of your booklet so that you will be ready for the next tape segment. There will be a 10-second blank period between each tape

segment to give you time to answer. You should be able to respond within this time period. However, at the beginning it may take a bit longer since you will be unfamiliar with the procedure. Therefore, I will stop the videotape if you find you need additional time. Please make responses to all segments. If you are unsure, you should guess what emotion the person is conveying. In addition, it is important to remember that the segments are in no particular order. Therefore, make each decision independent of the other decisions you have made. There may be instances of the same person doing the same emotion more than once, since there were a number of trials in the original study. Finally, you will be required to make a large number of judgments during this session. However, the length of each segment is very short. Therefore, viewing the whole tape will take approximately 35 minutes. There will be a short break halfway through the tape. Since we would like independent judgments, it is important that you do not talk while viewing the tape. Are there any questions before we start viewing the tape?

The decoders were provided with response booklets to record their answers. A page was provided for each videotape segment. Each page consisted of the following question: "Which of the following emotions do you think the person in the film segment was conveying? Indicate your choice by a checkmark." Alternatives were: anger, sadness, happiness, disgust, and fear.

The decoders were instructed to watch the complete 6 seconds of each

tape segment before making their responses. A brief rest period was provided half-way through the session because of the large number of judgments required in the 50-minute session. Prior to viewing the videotapes the subjects were asked to read the subject consent forms and all subjects agreed to participate in the study.

At the beginning of the second session the experimenter briefly reviewed the procedure; otherwise, the second viewing session was identical to the first. At the end of the second session, subjects were debriefed and were given experimental points for participating in the study.

Method of Analysis

The dependent measure for the present study was accuracy of communication. Since decoders viewed all encoders in all experimental conditions (within an intensity level), their accuracy of detecting the emotion intended by encoders was used as an index of communication accuracy. These scores were computed by first determining for each videotape segment whether the decoder had correctly identified the emotion. A score of "1" was assigned if the decoder's response was correct; if the decoder's response was incorrect a score of "0" was assigned. The decoders viewed 10 male and 9 female encoders for each cell of the design. The accuracy score was the percent of encoders correctly decoded. Thus, if a decoder chose the correct emotion for 5 of the 10 encoders, he or she received a score of 50. The highest score possible was 100.

A 2 x 3 x 2 x 3 x 5 mixed analysis of variance (ANOVA) was performed on the data. Between-subjects variables were sex of decoder and intensity

of emotion. The within-subjects variables were sex of encoder, encoding condition, and emotion. This analysis revealed that, with few exceptions, emotion interacted with all other variables. Thus, to simplify the presentation of results, a separate 2 x 3 x 2 x 3 mixed ANOVA was conducted for each emotion. The between-subjects variables were sex of decoder and intensity of emotion. The within-subjects variables were sex of encoder and encoding condition. The use of five univariate analyses of variance may arbitrarily inflate the alpha level for F tests; to control for this possibility the present study employed the .01 level of significance.

Results

Encoding Condition

The present study is concerned with the impact of the paralinguistic channel on the ability to encode facial expressions of emotion. Does access to the paralinguistic channel facilitate or inhibit the encoding of emotion by facial expressions? In addition, the study attempted to determine which components of the paralinguistic channel contribute to encoding of facial expressions: the systematic facial movements of speech or the production of vocal intonations appropriate to the emotions. The study therefore examined the impact of systematic facial movements on the ability to encode facial expressions of emotion.

To evaluate these questions, decoders viewed silent videotapes depicting facial expressions of emotion encoded three ways: facial channel alone, facial channel plus paralinguistics, and facial channel plus mouthing. Accuracy scores were derived as described earlier, and the data for each emotion were subjected to a 2 x 3 x 2 x 3 ANOVA. The results of these five ANOVA's are summarized in Table 1.

As indicated in Table 1, the main effect for the encoding condition was statistically significant for fear, F (2,108) = 47.69, $p < .001$, sadness, F (2,108) = 69.65, $p < .001$, and anger, F (2,108) = 61.35, $p < .001$. Happiness, F (2,108) = 00.40, ns, and disgust, F (2,108) = 3.48, ns, did not yield significant effects for encoding condition. For happiness, the absence of a main effect is attributable to a significant interaction

Table 1

Results of Significance Tests for Main Effects and Interactions by Emotion

Source	Emotion				
	Fear	Anger	Sadness	Happiness	Disgust
Sex of decoder (A)	-	-	**	-	-
Intensity of emotion (B)	-	**	**	**	**
A x B	-	-	-	-	-
Sex of encoder (C)	**	**	**	**	**
A x C	-	-	-	-	-
B x C	*	-	-	**	-
A x B x C	-	-	-	-	-
Encoding condition (D)	**	**	**	-	-
A x D	-	-	-	-	-
B x D	*	-	**	-	-
A x B x D	-	-	-	-	-
C x D	*	*	-	**	-
A x C x D	-	-	-	-	-
B x C x D	**	-	-	**	-
A x B x C x D	-	-	-	-	-

* $p < .01$.

** $p < .001$.

between the sex of the encoder and the encoding condition; male and female encoders showed opposite trends. Therefore, in presenting the main effects for encoding condition, the results for happiness are presented separately by the sex of the encoder. Table 2 shows the mean accuracy score for each encoding condition for fear, sadness, anger, happiness (female encoders), and happiness (male encoders).

The specific comparisons relevant to the hypotheses involve determining the impact of the two "speaking" conditions (facial channel plus paralinguistics and facial channel plus mouthing) relative to communication accuracy by the facial channel alone. Thus, to determine the effect of utilizing the paralinguistic channel on the ability to encode facial expressions of emotion, decoding accuracy for the facial channel plus paralinguistics encoding condition was compared to the decoding accuracy for the facial channel alone encoding condition. To determine whether the systematic face movements involved in the paralinguistics channel was a contributing factor, decoding accuracy was compared for the facial channel plus mouthing and the facial channel alone condition. For each comparison, difference scores were calculated and tested using the Tukey (1953) HSD statistic (cited in Kirk, 1968).

Table 3 presents difference scores and results of the post hoc tests for the comparisons described. [A positive sign indicates that access to paralinguistics or systematic face movements (mouthing) had a facilitative impact on the accuracy of communicating the emotion by facial expressions. A negative sign indicates that employing paralinguistics or systematic face movements had an inhibitory effect on the accuracy of

Table 2

Accuracy Scores for Encoding Conditions

Emotion	Encoding conditions		
	Facial channel alone	Facial channel plus mouthing	Facial channel plus paralinguistics
Fear	46.45	31.09	27.79
Sadness	77.00	72.34	55.45
Anger	33.39	55.32	42.39
Happiness (female encoders)	78.83	84.00	80.33
Happiness (male encoders)	67.04	61.49	62.92

Note. Higher numbers indicate greater decoding accuracy. Maximum score = 100.

Table 3

Critical Comparisons Among Encoding Conditions

Emotion	Comparison (difference score)	
	Facial channel plus paralinguistics minus facial channel alone	Facial channel plus mouthing minus facial channel alone
Fear[a]	-8.66*	-15.36*
Sadness[b]	-21.55*	-4.66*
Anger[c]	+9.00*	+21.93*
Happiness (female encoders)[d]	+1.50	+5.17
Happiness (male encoders)[e]	-4.12	-5.55*

*$p < .05$.

a. HSD (108) = 4.86.

b. HSD (108) = 4.58.

c. HSD (108) = 4.74.

d. HSD (108) = 5.46.

e. HSD (108) = 5.46.

communicating the emotion by facial expressions.] It is clear from Table 3 that access to the paralinguistic channel had a significant inhibitory effect on encoding facial expressions for fear and sadness. The facial expressions were decoded less accurately for the facial channel alone condition. On the other hand, access to the paralinguistic channel had a facilitative effect for encoding facial expressions of anger. Anger encoded in the facial channel plus paralinguistics condition was more accurately decoded than anger encoded in the facial channel alone condition. Happiness encoded by females or males showed no difference in accuracy for these two encoding conditions.

Results for the second comparison (facial channel plus mouthing vs. facial channel alone) paralleled the effects for the facial channel plus paralinguistics condition but were, in general, more pronounced. Mouthing the standard sentences had a significant inhibitory effect on the ability to encode facial expressions of fear, sadness, and happiness (male encoders). The expression of anger was significantly facilitated in the mouthing condition, and a marginal facilitative effect was observed for happiness (female encoders). For each emotion the impact of both paralinguistics and mouthing was always in the same direction, i.e., both encoding conditions always had either a facilitative or an inhibitory effect. Moreover, with the exception of sadness, the impact of mouthing was consistently greater than the impact of paralinguistics. (The only difference between these two encoding conditions is the production of audible speech.)

Table 1 indicates that a number of additional interactions were

statistically significant. For the most part, these interactions were due to magnitude rather than differential effects. One interaction that showed systematic trends will be described.

The interaction between the sex of encoder and the encoding condition for fear indicated that the facilitative effect for access to the paralinguistic channel was stronger for encoding male than for females (difference score + 10.33 vs. 6.67, respectively). The opposite was true for the facilitative effects of mouthing; that is, the difference between encoding by the facial channel plus mouthing condition and the facial channel alone condition was greater for female (26.33) than male (17.52) encoders.

Sex Differences

The results strongly supported the predictions for the sex of the encoder. Table 4 reveals that for fear, F (1,54) = 94.33, $p < .001$, sadness, F (1,54) = 119.87, $p < .001$, anger, F (1,54) = 124.96, $p < .001$, happiness, F (1,54) = 219.39, $p < .001$, and disgust, F (1,54) = 45.87, $p < .001$, female encoders were more accurately decoded than male encoders.

Males and females were not expected to differ in their ability to decode facial expressions of emotion. The results support this expectation for fear, F (1,54) = 0.31, ns, anger, F (1,54) = 0.00, happiness, F (1,54) = 0.37, ns, and disgust, F (1,54) = 0.97, ns. Sex of decoder was, however, significant, for sadness, F (1,54) = 14.16, $p < .001$. Female decoders (M = 72.64) were more accurate at identifying sadness than male decoders (M = 63.88). It is apparent from Table 1 that all interactions of sex of encoder by sex of decoder were nonsignificant.

Table 4

Mean Accuracy Scores for Male and Female Encoders for Each Emotion

Emotion	Sex of encoder	
	Male	Female
Fear	28.95	41.27
Anger	35.24	52.17
Sadness	59.65	76.88
Happiness	63.81	81.06
Disgust	41.14	53.03

Note. Higher numbers indicate greater decoding accuracy. Maximum score = 100.

Intensity of Emotion

A main effect was predicted for intensity of emotion. Results showed that main effects were statistically significant for sadness, F (2,54) = 17.39, $p < .001$, anger, F (2,54) = 9.96, $p < .001$, happiness, F (2,54) = 58.72, $p < .001$, and disgust, F (2,54) = 5.79, $p < .01$. (Table 5 presents the mean accuracy for these main effects.) The main effect for intensity was not significant for fear, F (2,54) = 2.84, ns.

It was also predicted that expressions encoded with extreme intensity would be more accurately decoded than emotions encoded with slight intensity. For each emotion, the means shown in Table 5 were examined using Tukey's (1953) HSD statistic. In all cases, the prediction was confirmed--extreme expressions were decoded with significantly more accuracy than slight expressions ($p < .05$). The results concerning the predicted effect for moderate intensity were not so unequivocal. Inspection of the means shown in Table 5 indicates that decoding accuracy for the moderate intensity condition consistently fell between the accuracy levels for the slight and extreme conditions, as predicted. However, the moderate condition was significantly different from both the slight and extreme conditions only for happiness ($p < .05$).

A significant interaction for intensity of emotion by sex of encoder was obtained for fear, F (2,54) = 6.83, $p < .01$, and happiness, F (2,54) = 21.42, $p < .001$. Examination of Tables 6 and 7 indicates that the magnitude of encoder sex differences was not consistent across intensity levels. Sex differences were largest for encoding slight and moderate

intensities, but showed a reduction for the extreme intensity level. This particular effect was more pronounced and linear for happiness than for fear.

Table 5

Mean Accuracy Scores for Intensity of Emotion for Anger, Sadness, Happiness, and Disgust

Emotion	Intensity of emotion		
	Slight	Moderate	Extreme
Sadness[a]	59.05	70.20	75.53
Anger[b]	36.82	44.09	50.19
Happiness[c]	56.33	70.19	90.78
Disgust[d]	42.13	46.92	52.21

Note. Higher numbers indicate greater decoding accuracy. Maximum score = 100.

a. HSD (108) = 6.07.

b. HSD (108) = 6.38.

c. HSD (108) = 6.19.

d. HSD (108) = 6.32.

Table 6

Accuracy Scores for Intensity Levels of Fear as a Function of Sex of Encoder

Sex of encoder	Intensity of emotion		
	Slight	Moderate	Extreme
Males	25.95	24.37	36.54
Females	36.83	43.00	43.96

Note. Higher numbers indicate greater decoding accuracy. Maximum score = 100.

Table 7

Accuracy Scores for Intensity Levels of Happiness as a Function of Sex of Encoder

Emotion	Intensity of emotion		
	Slight	Moderate	Extreme
Males	43.33	61.05	87.07
Females	69.33	79.33	94.50

Note. Higher numbers indicate greater decoding accuracy. Maximum score = 100.

Discussion

The present results support the position that nonverbal channels are not independent systems, but are interdependent and exert influence on each other. The study focused on the influence of the paralinguistic channel on the accuracy of communicating by the facial channel. The prediction was confirmed that encoding facial expressions of emotion would be influenced by access to the paralinguistic channel. The nature of the impact was more complex than predicted, however. The expectation that the paralinguistic channel would have a consistent facilitative or a consistent inhibitory effect on encoding by the facial channel was not confirmed. Results showed both facilitative and inhibitory effects due to access to the paralinguistic channel depending on the emotion encoded by facial expressions.

Examination of components of the paralinguistic channel revealed that systematic facial movements rather than vocal intonations was the crucial factor. Both the facilitative and inhibitory effects obtained in the present study were more extreme for the facial channel plus mouthing condition (systematic face movements) than for the facial channel plus paralinguistics condition (systematic face movements plus vocal intonations). This indicates that the production of the vocal intonations tempered both the facilitative and inhibitory effects of systematic mouth movements on the ability to encode by facial expressions.

In general, the study revealed that encoding facial expressions of

anger and happiness (female encoders) were facilitated by mouthing and by producing paralinguistic responses. The former had a greater impact than the latter condition. Encoding facial expressions of fear, sadness, and happiness (male encoders) were inhibited by mouthing and by producing the appropriate paralinguistics. With the exception of sadness, these inhibitory effects on the facial channel were greater for mouthing than for actually producing paralinguistic responses.

The first question that these results raise concerns the different impact of the two "speaking" conditions (facial channel plus paralinguistics and facial channel plus mouthing) on the facial display of emotion. Both conditions require the same systematic face movements; the only difference is the actual production of audible vocalizations in the facial channel plus paralinguistics condition. Reports from the encoders suggest a possible explanation for the weaker facilitative effect in the facial channel plus the paralinguistics condition than in the facial channel plus the mouthing condition. A number of encoders stated that they found the mouthing condition conducive to encoding the emotions--that they were able to imagine the appropriate intonations while mouthing. In the facial channel plus paralinguistics condition, feedback from the audible vocal intonations was often inconsistent with the imagined or intended intonation. Consequently, encoding was disrupted, and the potential positive effect of access to the paralinguistic channel was curtailed.

If the production of the actual vocal intonations was to some extent disruptive, why was this not consistently the case? Remember that

the facial channel plus the paralinguistics condition was better (i.e., had a weaker inhibitory effect) than the facial channel plus the mouthing condition for fear and happiness (male encoders). It appears that the systematic face movements involved in mouthing the sentences are changed in some fashion by actually vocalizing in the facial channel plus the paralinguistics condition. For example, inspection of the videotapes indicated that, for fear and happiness (male encoders), mouthing the sentences sometimes resulted in exaggerated facial movements. To produce the appropriate intonations (paralinguistics condition) the facial configurations appeared more subtle, more "natural."

Results of the present study showed that producing facial expressions of emotions may be facilitated or inhibited by the opportunity to produce facial movements. The component of the facial movements affected by vocalizations must be a central agent in influencing the ability to produce the facial expressions, since it tempered both the facilitative and inhibitory effects in the present study. This suggests that further investigation should attempt objectively to analyze the facial expressions produced by the facial channel plus paralinguistics condition and the facial channel plus mouthing condition. Since encoders produced facial expressions under all encoding conditions (within-subjects design), it should be possible to determine the differences in the facial patterns for the mouthing and paralinguistics conditions.

At this point we should reiterate that the findings of the present study indicate that the factor influencing the facial channel is access

to systematic face movements. In discussing the results further, we will, for the most part, no longer refer to these encoding conditions per se, but to the factor within these conditions that is responsible for the effects, namely, the systematic facial movements. This term may be misleading to some extent. It does not imply that a set pattern of mouth movements was consistently produced and remained constant in all encoding conditions. To produce the words of the standard sentences an underlying set of mouth movements is necessary. But, subjects could (and did) modify this basic set of required mouth movements with a particular emotion and intensity of emotion. With this caveat in mind, we may consider other questions raised by the results of the present study.

Why should systematic facial movements have a facilitative effect on encoding expressions of happiness (female encoders) and anger, and an inhibitory effect on encoding the expressions of fear, sadness, and happiness (male encoders)?

Research on differential communicability of the face helps to explain the effects obtained in the present study. Boucher and Ekman (1975) demonstrated that happiness and anger are most accurately conveyed by the lower portion of the face, whereas sadness and fear are more accurately communicated by the upper part of the face. In other words, the upper part of the face is more capable of differentiating fear and sadness than the lower part of the face. In contrast, the lower part of the face provides more cues to happiness and anger than the upper part of the face. These results have direct implications for the present study. The experimental

conditions involving talking or mouthing require the subjects to produce face changes in the lower half of the face (i.e., there is a minimum set of mouth movements concomitant to saying or mouthing the standard sentences). Consideration of differences in the facial area found by previous researchers suggests a number of explanations for the present effects.

Since fear and sadness are best communicated by cues in the upper half of the face, the simultaneous production of cues in the lower half of the face for conditions involving systematic face movements may conflict with the appropriate facial expressions for fear and sadness. For example, perhaps accurate communication of these emotions requires the absence of facial cues in the lower half of the face. Although subjects in conditions involving systematic face movements provided the appropriate cues, the required mouth movements elicited inappropriate cues. For emotions that are dependent on the lower half of the face, the required mouth movements could be modified to express emotion-appropriate cues. Thus, the requirement of producing systematic facial movements would facilitate the expression of emotions that are well differentiated in the lower half of the face.

An even stronger argument for this position is possible. Conditions involving systematic facial movements may have caused encoders to focus on the production of cues in the lower half of the face. If subjects were oriented to the production of cues in the lower part of the face and if the emotions of happiness and anger are represented most accurately in

this area, then accurate encoding would be expected. Fear and sadness are, however, best identified from upper face cues. Therefore, emphasis on lower face cues would reduce the accurate expression of these emotions.

These explanations can account for the results obtained, with the exception of happiness by males and the lack of effects for disgust. The results for happiness encoded by males indicated that the production of systematic face movements reduced their ability to communicate this emotion by facial expressions. Since the research on communicability of facial areas has not examined sex differences, we can only speculate that males may be more dependent on upper-face cues than lower-face cues. The lack of significant differences in encoding conditions for disgust is probably due to a definitional problem. The emotion of disgust may take two forms: (a) disgust in reaction to an object (e.g., food), or (b) disgust in an interpersonal situation--a type of contempt. This distinction has been pointed out by Ekman (1971). In the present study, it is very likely that subjects varied in their interpretation of what type of disgust was to be conveyed. In fact, one subject did ask during the debriefing whether she should have portrayed disgust toward another person rather than disgust at the sight of a distasteful object. Another subject, when reporting the emotion he found easiest to encode, chose this emotion because he currently was disgusted with a friend. Our previous examination of the type of emotion portrayed by the different facial areas revealed that reactive (passive) emotions are expressed more accurately by the upper than the lower half of the face (e.g., sadness and fear), but the

reverse was the case for the more active (overt) types of emotion (e.g., anger, happiness). The disgust toward objects would seem to fit the former category (reactive-passive) and the interpersonal disgust, the latter category (active-overt). Let us assume, first, that the two types of disgust are accurately conveyed in different parts of the face, and, second, that encoding that employs systematic mouth movements facilitates the expression of emotions typically conveyed by the lower half of the face and inhibits the expression of upper-face emotions. It is suggested that the different interpretations of disgust led to opposite trends that effectively cancelled each other, resulting in no significant encoding condition effect for disgust.

The explanations provided for the results of the present study can be tested by an objective analysis of encoders' facial expressions. The analysis would focus on the emotional cues exhibited in the upper and lower parts of the face. One possible technique would be the application of Ekman, Friesen, and Tomkins' (1971) facial affect scoring technique (FAST). These authors have provided a detailed description of the cues in each of three areas of the face (eyes/eye lids, brows/forehead, lower face) that are indicative of the primary emotions (fear, anger, sadness, happiness, surprise, and disgust).

An objective analysis of emotional cues could be employed to test the explanations offered for results of the present study. The first explanation suggested that systematic facial movements necessarily produce lower face cues. Since the areas of the face are differentially accurate

in communicating emotions, this will facilitate or inhibit the encoding of facial expressions, depending on the emotion. The second explanation suggested that, for encoding conditions involving systematic face movements, encoders may have employed cues only in the lower half of the face. The first explanation predicts the following effects for the objective analysis:

1. Upper half of the face--no differences between the facial channel alone encoding condition and the encoding conditions involving systematic face movements.

2. Lower half of the face--for fear, sadness, and happiness (male encoders), a greater number of inappropriate cues for encoding conditions involving systematic face movements as compared to the facial channel alone, (encoding condition). For anger and happiness (female encoders), a greater number of appropriate cues in encoding conditions involve systematic face movements than in the facial expressions alone [encoding condition]. The second explanation would be supported if results for the upper face did show nonverbal cue differences for the encoding conditions. Specifically, the encoding conditions involving systematic face movements should have fewer cues for all emotions as compared to the facial channel alone. The same effects for lower face cues as described above would be expected.

The two explanations both suggest that encoders' use of systematic face movements produces a greater number of lower face cues. For emotions expressed in the lower half of the face this would be facilitative, but

for emotions expressed in the upper half of the face this would be inhibitory.

It is necessary to consider the possibility that the results may be attributed to a decoder effect. That is, the appropriate emotional cues may not differ by the encoding condition. Instead, the systematic activity in the lower face in the paralinguistic and mouthing conditions may have caused decoders to attend to lower face cues--attention is drawn to the movement of the mouth (Kahneman, 1973). In the facial channel alone condition, decoders would employ cues from the whole face. If decoders focused primarily on lower face cues they would miss important information about emotions best portrayed in the upper half of the face. Focusing on the lower face for the emotions best differentiated in this area would produce greater decoding accuracy. Thus, if the results of the present study were due to a decoder artifact, the objective analysis of facial areas would show no difference between the facial channel alone and the "speaking" conditions. Although it is impossible to rule out decoder artifact without an objective analysis, the explanation is weakened by the presence of encoding condition effects in the present study (i.e., facilitative and inhibitory effects were different for the facial channel plus paralinguistics and the facial channel plus mouthing conditions).

The present study also investigated sex differences in the ability to encode and decode facial expressions of emotion. On the basis of previous research, sex differences were predicted for encoding but not for decoding of facial expressions of emotion. The results provided strong

support for the hypothesis that females are superior to males in their ability to encode facial expressions of emotion. This effect was significant for each of the emotions employed in the present study.

With the exception of sadness, the prediction was confirmed that males and females would not differ in their ability to decode facial expressions of emotion. These results indicate that both males and females are equally aware of the facial cues appropriate to the emotion. Why then, were males less accurate in portraying these emotions? This result may be due to socialization of appropriate sex-role behavior. Buck (1977) suggested that for males, overt expressions of emotion are discouraged during their developmental process.

The present study also examined intensity of emotion. It was predicted that emotions encoded at extreme intensities would be more accurately decoded than emotions encoded at slight intensity levels, and emotions encoded at moderate intensity levels were expected to fall midway between slight and extreme intensities. The prediction received partial support. The extreme intensities of emotions were decoded more accurately than the slight intensities. But the accuracy level for moderate intensities only fell (significantly) between extreme and slight intensities for happiness. The prediction for intensity was based on the assumption that more cues would be provided when encoding increasing intensities of emotions. The results for intensity of emotion indicate that subjects had difficulty encoding moderate expressions of emotion. That is, they were able to differentiate slight and extreme, but actually portrayed moderate

intensity in a manner equivalent to slight in some cases and to extreme in other cases.

In summary, the results indicate that the nonverbal channels seem to be interdependent; the direction of the impact of the paralinguistic channel on the facial channel depended, however, upon the emotion being conveyed. Since the tutor role requires a considerable amount of overt expression of approval and positive affect, the present results may have implications for training tutors in the social skills required in the tutoring situation. Tutors may be more effective as encoders if they are trained to use multiple nonverbal channels when communicating. The present study indicates that the accuracy of nonverbal encoding can be facilitated within a channel by employing multiple nonverbal channels. Further research is needed, however, to ascertain whether the theoretical explanation offered for the interdependence across nonverbal channels is also applicable when expressing the type of affective and cognitive information most relevant to the tutoring situation.

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